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(54) [Title of the invention]

Phase Difference Compensating Film.

(57) [Summary] (There exists a correction)

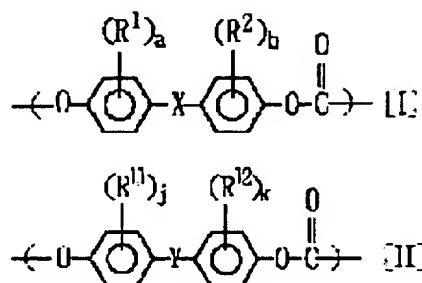
[Aim]

To offer a polycarbonate group phase difference compensating film that can control the retardation value within an appropriate range and reduce the variation in retardation value remarkably.

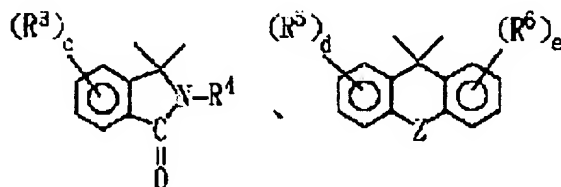
[Composition]

The phase difference compensating film that is formed from the cast film or cast sheet of polycarbonate that possesses repetitive units [I] shown by the formula [I]

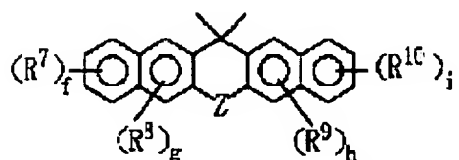
or repetitive units [I] and repetitive units [II] shown by the formula [II] and has the reduced viscosity $[\eta_{sp}/c]$ of 0.5 ~ 2.5 dl/g.



[Wherein, X shows the radical given below,



or



$\text{R}^1 \sim \text{R}^3$ and $\text{R}^5 \sim \text{R}^{12}$ independently show halogen atom, alkyl radical, cyclo alkyl radical or aryl radical etc., R^4 shows hydrogen atom, alkyl radical or cyclo alkyl radical, a ~ f and i ~ k are integers from 0 ~ 4, g and h are integers from 0 ~ 2 and Z is a single bond, - CO -, - S -, - SO -,

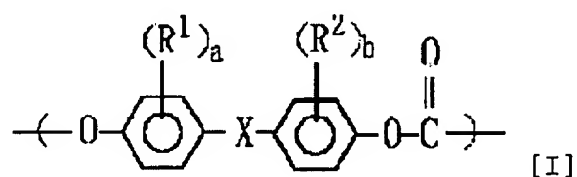
- SO₂ - or - CH₂ - and Y is a single bond, - O -, - CO -,
 - S -, - SO -, - SO₂ - etc.]

[Scope of patent claims]

[Claim 1]

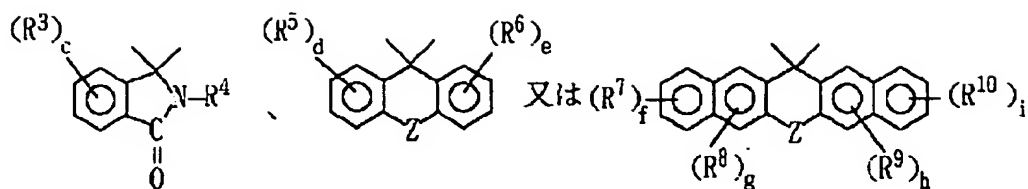
The phase difference compensating film has the characteristic of being formed from the cast film or cast sheet of polycarbonate that possesses repetitive units [I] shown by the general formula [I] given below,

[Formula 1]



[Wherein, R¹ and R² independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, a and b are integers from 0 ~ 4, X shows the radical given below.

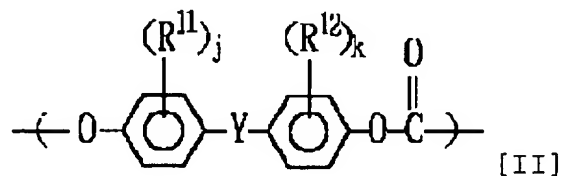
[Formula 2]



(Japanese character in the above figure means "or")

(Wherein, R^3 , R^5 , R^6 , R^7 , R^8 , R^9 and R^{10} independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, R^4 shows hydrogen atom, alkyl radical or cyclo alkyl radical having 1 ~ 12 carbon atoms, c , d , e , f and i are integers from 0 ~ 4, g and h are integers from 0 ~ 2 and Z is a single bond, - CO -, - S -, - SO -, - SO₂ - or - CH₂ -) or repetitive units [I] and repetitive units [II] shown by the general formula [II] given below,

[Formula 3]



(Wherein, R^{11} and R^{12} independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms, cyclo alkyl radical

having 5 ~ 7 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, j and k are integers from 0 ~ 4, Y a single bond, - O -, - CO -, - S -, - SO -, - SO₂ -, CR¹³R¹⁴ - (wherein, R¹³ and R¹⁴ independently show hydrogen atom, tri fluoro methyl radical, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms.), cyclo alkylidene radical having 5 ~ 8 carbon atoms or α , ω - alkylene radical having 2 ~ 12 carbon atoms.], and having the reduced viscosity $[\eta_{sp}/c]$ measured over the solution formed by using methylene chloride as the solvent and having concentration of 0.5 g/dl at 20°C within the range from 0.5 ~ 2.5 dl/g.

[Detailed description of the invention]

[0001]

[Industrial applicability]

The present invention relates to the phase difference compensating film. In further details, the present invention relates to highly functional optical phase difference

compensating film that is particularly useful as the phase difference compensating film used in liquid crystal panel.

[0002]

[Techniques of the past]

Polycarbonate is being used in different fields as basic material due to its excellent mechanical strength, heat resistance and excellent optical properties such as transparency and dimensional stability. However, development of a material having further excellent properties is demanded for, accompanying the widening of application during the recent years.

[0003]

The most representative polycarbonate is the one that is obtained by the reaction between bis phenol A and phosgene and other than these, different types are also known. However, polycarbonate having what type of structure is most desirable is a basic question which is not clear as yet. Therefore, from the point of this application development, type of

polycarbonate that is most suitable to the respective application is required to be chosen and properties corresponding to this application are required to be imparted.

[0004]

However, optical phase difference compensating film (sheet form or plate form, for example, phase difference sheet or phase difference plate etc., however, there is no particular restriction over this in the present invention and it is called as optical phase difference compensating film including these) is one of the applications of polycarbonate that is attracting attention. The optical phase difference compensating film possesses double refraction (birefringence) and possesses the function of generating the phase difference along the right angle direction in the incident light of straight polarized light and converting the transmitting light into circular or elliptical polarized light, and it is used in different

types of optical machines or devices such as liquid crystal panel etc.

[0005]

In the case of using optical phase difference compensating film in this application, one of its property, retardation value (called as R. Moreover, this R value is the product of thickness t of film or sheet and its double refraction (birefringence) Δn , namely, $R = t \times \Delta n$ and it is expressed in the unit nm.) is near 135 nm, and phase difference film generating optical path difference of $1/4$ wavelength or more than that, for example, approximately 600 nm is suitable to be used. Moreover, in order to obtain highly functional phase difference film, cast film or cast sheet is required to be prepared such that there is no variation in the R value in entire film or sheet.

[0006]

Cellulose acetate group film or sheet was used in such optical phase difference compensating film in the past.

During the recent years, use of polycarbonate group film or sheet as optical phase difference compensating film was suggested from the point of dimensional stability and making it thin (for example, refer to Patent number Sho 63 - 189804, Hei 1 - 201608). However, in this cast film or sheet formed from the material of the past, difference in the optical properties between the parts of casted film or sheet for example, between central part and both the end part is large, due to which the final phase difference compensating film can be taken out only from the central part of cast film or sheet.

[0007]

Moreover, at the time of using polycarbonate group film or sheet as the optical phase difference compensating film, polycarbonate material, its casting method and casting conditions were studied with the aim of obtaining uniform R value (refer to Patent number Hei 4 - 84107). However, in the techniques of the past, sufficiently uniform R value

could not be obtained and development of a still highly functional phase difference compensating film with no variation in R value under optical crossed nicols, namely, no color irregularity is demanded for.

[0008]

[Problems the invention solves]

The present invention has been devised based on the circumstances mentioned above. The present invention aims at solving the problems mentioned above and offering a highly functional polycarbonate group optical phase difference compensating film that can control the retardation value within an appropriate range, reduce the variation in retardation value remarkably and is suitable to be used as the phase difference compensating film used in liquid crystal panel.

[0009]

[Method to solve the problems]

The authors of the present invention carried out an earnest

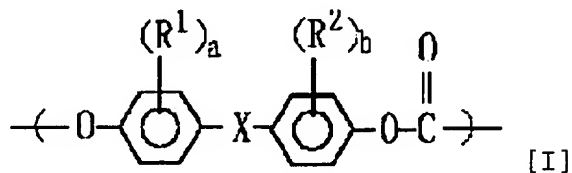
research in order to attain the aim mentioned above as a result of which they showed that highly functional optical phase difference compensating film satisfying the aim mentioned above can be obtained by using a casted film or sheet of polycarbonate possessing a specific repetitive units. Based on this knowledge, the present invention was completed.

[0010]

Namely, the present invention offers the phase difference compensating film that has the characteristic of being formed from the cast film or cast sheet of polycarbonate that possesses repetitive units [I] shown by the general formula [I] given below,

[0011]

[Formula 4]

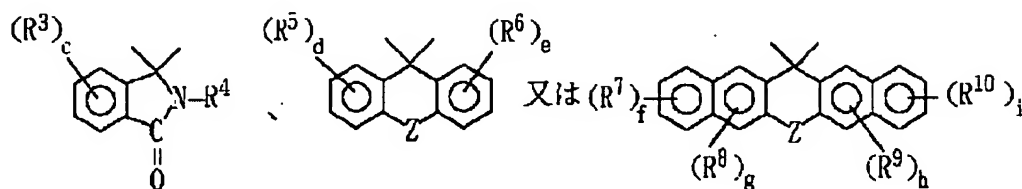


[Wherein, R¹ and R² independently show halogen atom, alkyl

radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, a and b are integers from 0 ~ 4, X shows the radical given below.

[0012]

[Formula 5]



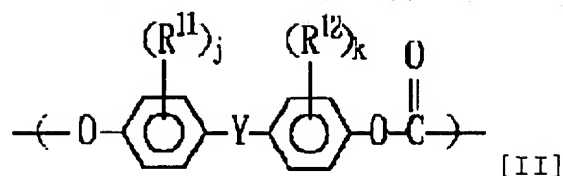
(Japanese character in the above figure means "or")

(Wherein, R^3 , R^5 , R^6 , R^7 , R^8 , R^9 and R^{10} independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, R^4 shows hydrogen atom, alkyl radical or cycloalkyl radical having 1 ~ 12 carbon atoms, c, d, e, f and i are integers from 0 ~ 4, g and h are integers from 0 ~ 2 and Z is a single bond, - CO -, - S -, - SO -, - SO₂ - or - CH₂ -) or repetitive units [I] and repetitive units

[II] shown by the general formula [II] given below,

[0013]

[Formula 3]



[Wherein, R¹¹ and R¹² independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms, cyclo alkyl radical having 5 ~ 7 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms, j and k are integers from 0 ~ 4, Y a single bond, - O -, - CO -, - S -, - SO -, - SO₂ -, CR¹³R¹⁴ - (wherein, R¹³ and R¹⁴ independently show hydrogen atom, tri fluoro methyl radical, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms.), cyclo alkylidene radical having 5 ~ 8 carbon atoms or α, ω - alkylene radical having 2 ~ 12 carbon atoms.], and having the reduced viscosity [η_{sp}/c] measured over the solution formed by using methylene chloride as the solvent and having concentration of 0.5

g/dl at 20°C within the range from 0.5 ~ 2.5 dl/g.

[0014]

The casted film or sheet formed from polycarbonate mentioned above is used in the phase difference compensating film of the present invention, however, as regards the polycarbonate mentioned above, use of at least 1 type from the polycarbonate formed from repetitive units [I] shown by the general formula [I] given above and polycarbonate formed from repetitive units [I] given above and repetitive units [II] shown by the general formula [II] given above is important. As regards this polycarbonate, different polycarbonate homo or copolymers formed from 1 or more than 1 types of repetitive units among repetitive units [I] given above and different polycarbonate copolymers formed from 1 or more than 1 types of repetitive units [I] and 1 or more than 1 types of repetitive units [II] can be used. Moreover, it can also contain other repetitive units within the range such that gist of the present invention is not

lost. Particularly, in the case of copolymer possessing repetitive units [I] and repetitive units [II], content of repetitive units [I] with respect to total content of repetitive units [I] and [II] is desired to be more than 1 mole %.

[0015]

Moreover, these polycarbonates can be used independently or as a mixture of 2 or more than 2 types as per requirement. Moreover, in the case of casting the polycarbonates, other polymer component or other components such as additives can be added as per requirement.

[0016]

In the general formula [I], R^1 , R^2 , R^3 , R^5 , R^6 , R^7 , R^8 , R^9 and R^{10} independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms.

[0017]

The concrete examples of substitution radical R^1 , R^2 ,

R^3 , R^5 , R^6 , R^7 , R^8 , R^9 and R^{10} have been given below.

[0018]

As regards the halogen atom, fluorine atom, chlorine atom, bromine atom or iodine atom can be given. As regards the alkyl radical, methyl radical, ethyl radical, n - propyl radical, iso propyl radical, n - butyl radical, sec - butyl radical, tert - butyl radical, iso butyl radical, n - pentyl radical, iso pentyl radical, sec - pentyl radical, tert - pentyl radical, neo pentyl radical, n - hexyl radical, iso hexyl radical, sec - hexyl radical, tert - hexyl radical, neo hexyl radical, cyclo pentyl methyl radical etc. can be given. As regards the substituted or non-substituted aryl radical, phenyl radical, methyl phenyl radical, ethyl phenyl radical, propyl phenyl radical, butyl phenyl radical, di methyl phenyl radical, tri methyl phenyl radical, cyclo hexyl phenyl radical, p - bi phenyl radical, m - bi phenyl radical, 1 - naphthyl radical, 2 - naphthyl radical, methyl naphthyl radical, di methyl naphthyl radical, ethyl naphthyl

radical etc. can be given.

[0019]

In the general formula [I], R^4 shows hydrogen atom, alkyl radical or cyclo alkyl radical having 1 ~ 12 carbon atoms.

As regards the concrete examples of alkyl radical, examples given above and in addition to that, octyl radical, nonyl radical, decyl radical, undecyl radical, dodecyl radical etc. can be given. As regards the cycloalkyl radical, radical having 4 ~ 8 carbon atoms is desired, particularly, cyclohexyl radical is desired.

[0020]

In the general formula [II], R^{11} and R^{12} independently show halogen atom, alkyl radical having 1 ~ 6 carbon atoms, cyclo alkyl radical having 5 ~ 7 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms.

As regards the concrete examples of halogen atom, alkyl radical having 1 ~ 6 carbon atoms and aryl radical having 6 ~ 12 carbon atoms, examples given in case of general formula

[I] can be given. As regards the cyclo alkyl having 5 ~ 7 carbon atoms, cyclo hexyl radical is desired.

[0021]

In the general formula [II], Y a single bond, - O -, - CO -, - S -, - SO -, - SO₂ -, - CR¹³R¹⁴ -, cyclo alkylidene radical having 5 ~ 8 carbon atoms or α , ω - alkylene radical having 2 ~ 12 carbon atoms.

[0022]

Here, R¹³ and R¹⁴ of - CR¹³R¹⁴ - independently show hydrogen atom, tri fluoro methyl radical, alkyl radical having 1 ~ 6 carbon atoms or substituted or non-substituted aryl radical having 6 ~ 12 carbon atoms and as regards the examples of alkyl radical and aryl radical, examples mentioned above can be given.

[0023]

As regards the cyclo alkylidene radical of Y, 1, 1 - cyclo pentyldiene radical, 1, 1 - cyclo hexyldiene radical, 1, 1 - cyclo heptyldiene radical can be given. Among these

also, 1, 1 - cyclo hexylidene radical is desired.

[0024]

As regards α , ω - alkylene radical having 2 ~ 12 carbon atoms of Y, different poly methylene radicals from di methylene to deca methylene radical can be given.

[0025]

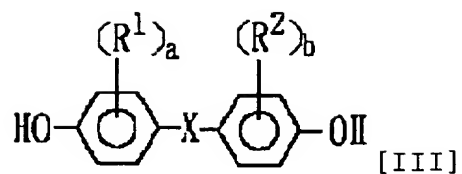
These different types of repetitive units [I] and repetitive units [II] can be formed from monomers possessing the corresponding structure, for example, these can be formed by reacting bis phenol type (divalent phenol type) having corresponding structure with phosgene. Here, instead of directly giving concrete examples of different types of repetitive units [I] and [II], concrete examples of bis phenol types corresponding to these are given.

[0026]

Bis phenol forming the repetitive units [I] is shown by the general formula [III] given below,

[0027]

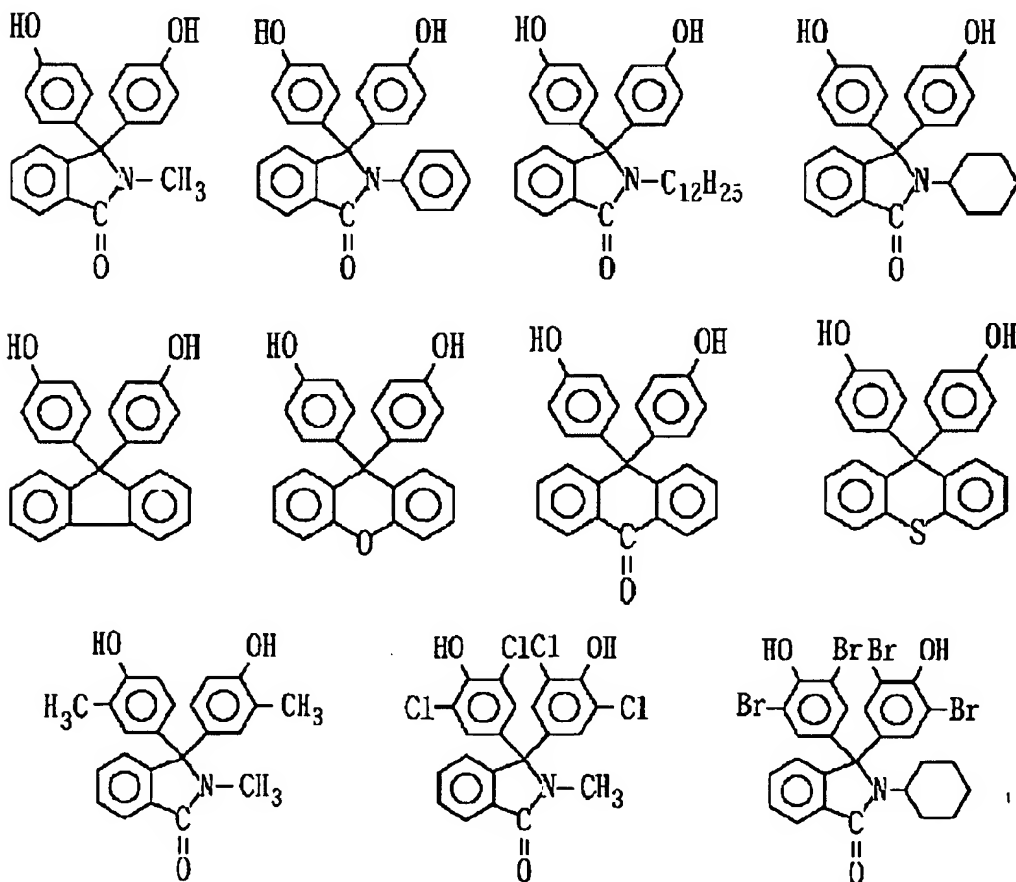
[Formula 7]

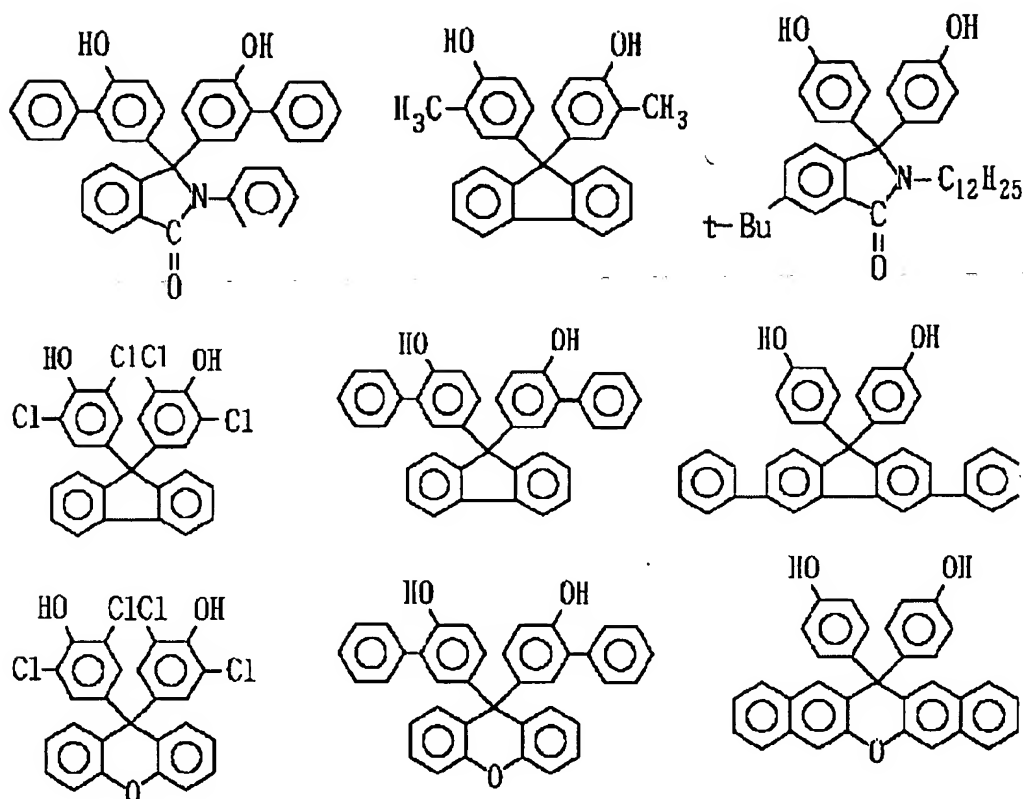


(Wherein, R¹, R², a, b and X mean the same as described above.) and as regards the concrete examples, the following compounds can be given.

[0028]

[Formula 8]

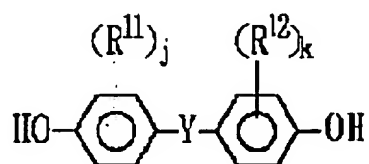




Bis phenol forming the repetitive units [III] is shown by the general formula [IV] given below,

[0029]

[Formula 9]



(wherein, R^{11} , R^{12} , j , k and Y mean the same as described above) and as regards the concrete examples, bis (4 - hydroxy phenyl) methane, 1, 1 - bis (4 - hydroxy phenyl) ethane,

1, 2 - bis (4 - hydroxy phenyl) ethane, 2, 2 - bis (4 -
 hydroxy phenyl) propane, 2, 2 - bis (3 - methyl - 4 - hydroxy
 phenyl) butane, 2, 2 - bis (4 - hydroxy phenyl) butane,
 2, 2 - bis (4 - hydroxy phenyl) octane, 4, 4 - bis (4 -
 hydroxy phenyl) heptane, 4, 4' - di hydroxy tetra phenyl
 methane, 1, 1 - bis (4 - hydroxy phenyl) - 1 - phenyl ethane,
 1, 1 - bis (4 - hydroxy phenyl) - 1 phenyl methane, bis
 (4 - hydroxy phenyl) ether, bis (4 - hydroxy phenyl) sulfide,
 bis (4 - hydroxy phenyl) sulfone, 1, 1 - bis (4 - hydroxy
 phenyl) cyclo pentane, 1, 1 - bis (4 - hydroxy phenyl) cyclo
 hexane, 2, 2 - bis (3 - methyl - 4 - hydroxy phenyl) propane,
 2 - (3 - methyl - 4 - hydroxy phenyl) - 2 - (4 - hydroxy
 phenyl) - 1 - phenyl ethane, bis (3 - methyl - 4 - hydroxy
 phenyl) sulfide, bis (3 - methyl - 4 - hydroxy phenyl) sulfone,
 bis (3 - methyl - 4 - hydroxy phenyl) methane, 1, 1 - bis
 (3 - methyl - 4 - hydroxy phenyl) cyclo hexane, 2, 2 - bis
 (2 - methyl - 4 - hydroxy phenyl) propane, 1, 1 - bis (2
 - butyl - 4 - hydroxy - 5 - methyl phenyl) butane, 1, 1

- bis (2 - tert - butyl - 4 - hydroxy - 3 - methyl phenyl)
 ethane, 1, 1 - bis (2 - tert - butyl - 4 - hydroxy - 5 -
 methyl phenyl) propane, 1, 1 - bis (2 - tert - butyl - 4
 - hydroxy - 5 - methyl phenyl) butane, 1, 1 - bis (2 - tert
 - butyl - 4 - hydroxy - 5 - methyl phenyl) iso butane, 1,
 1 - bis (2 - tert - butyl - 4 - hydroxy - 5 - methyl phenyl)
 heptane, 1, 1 - bis (2 - tert - butyl - 4 - hydroxy - 5
 - methyl phenyl) - 1 - phenyl methane, 1, 1 - bis (2 - tert
 - amyl - 4 - hydroxy - 5 - methyl phenyl) butane, bis (3
 - chloro - 4 - hydroxy phenyl) methane, 2, 2 - bis (3 -
 chloro - 4 - hydroxy phenyl) propane, 2, 2 - bis (3 - fluoro
 - 4 - hydroxy phenyl) propane, 2, 2 - bis (3 - bromo - 4
 - hydroxy phenyl) propane, 2, 2 - bis (3, 5 - di fluoro
 - 4 - hydroxy phenyl) propane, 2, 2 - bis (3, 5 - di chloro
 - 4 - hydroxy phenyl) propane, 2, 2 - bis (3, 5 - di bromo
 - 4 - hydroxy phenyl) propane, 2, 2 - bis (3 - bromo - 4
 - hydroxy - 5 - chloro phenyl) propane, 2, 2 - bis (3, 5
 di chloro - 4 - hydroxy phenyl) butane, 2, 2 - bis (3, 5

di bromo - 4 - hydroxy phenyl) butane, 1 - phenyl - 1, 1
 - bis (3 - fluoro - 4 - hydroxy phenyl) ethane, bis (3 -
 fluoro - 4 - hydroxy phenyl) ether, 3, 3' - di fluoro -
 4, 4' - di hydroxy phenyl, 1, 1 - bis (3 - cyclo hexyl -
 4 - hydroxy phenyl) cyclo hexane, 2, 2 - bis (4 - hydroxy
 phenyl) hexa fluoro propane, 1, 1 - bis (4 - hydroxy phenyl)
 - 1 phenyl - 2, 2, 2 - tri fluoro ethane, 2, 2 - bis (3
 - phenyl - 4 - hydroxy phenyl) propane, 1, 1 - bis (3 -
 phenyl - 4 - hydroxy phenyl) cyclo hexane, bis (3 - phenyl
 - 4 - hydroxy phenyl) cyclo hexane, bis (3 - phenyl - 4
 - hydroxy phenyl) sulfone, 4, 4' - di hydroxy benzo phenone,
 4, 4' - di hydroxy bi phenyl, 4, 4' - di hydroxy - 3, 3'
 - di methyl bi phenyl, 4, 4' - di hydroxy - 2, 2' - di methyl
 bi phenyl, 4, 4' - di hydroxy - 3, 3' - di cyclo hexyl bi
 phenyl etc. can be given.

[0030]

Among these bis phenols shown by the general formula [IV]
 also, 2, 2 - bis (4 - hydroxy phenyl) propane, 4, 4 - di

hydroxy tetra phenyl methane, 1 - phenyl - 1, 1 - bis (4 - hydroxy phenyl) ethane, bis (4 - hydroxy phenyl) sulfone, 1, 1 - bis (4 - hydroxy phenyl) cyclo hexane, 2, 2 - bis (3 - methyl - 4 - hydroxy phenyl) propane, 4, 4 - di hydroxy bi phenyl and 2, 2 - bis (3 - phenyl - 4 - hydroxy phenyl) propane etc. are desired to be used.

[0031]

As regards the polycarbonate used in the present invention, polycarbonate possessing different molecular structure such as straight chain, branched structure, cyclic structure or polycarbonate in which a specific structure is introduced at the polycarbonate terminals can be used.

[0032]

The reduced viscosity $[\eta_{sp}/c]$ of the polycarbonate used in the present invention, measured over the solution formed by using methylene chloride as the solvent and having concentration of 0.5 g/dl at 20°C should be within the range from 0.5 ~ 2.5 dl/g. If the reduced viscosity is less than

0.5 dl/g, then strength of film or sheet lowers whereas if it exceeds 2.5 dl/g, then its molding becomes difficult.

[0033]

Moreover, there is no particular restriction over the manufacturing method of this polycarbonate, and different methods such as phosgene method in which different bisphenols exemplified above are used as monomer and it is reacted with phosgene gas in the presence of alkali metal compound or acid receptor such as pyridine (in an appropriate solvent as per requirement) (interface polycondensation method, pyridine method etc.) or chloro formate method, ester exchange (transesterification) method etc. can be used. Moreover, in the case of this phosgene method, desired polycarbonate is manufactured either by reacting raw material bis phenol and phosgene once or 2-step method in which a part of reaction raw material bis phenol is reacted beforehand with phosgene to form oligomer possessing chloro formate radical at the molecular terminals and then, the

remaining part of reaction raw material is added and polycondensation is completed to manufacture the desired polycarbonate, can be used.

[0034]

The phase difference compensating film of the present invention is formed by molding · casting the basic material formed from at least 1 type of polycarbonate chosen from polycarbonate formed from repetitive units [I] given above or repetitive units [I] and repetitive units [II] given above. At this time, the polycarbonate mentioned above can be used independently or as a mixture and mixture formed with other components such as mixture formed with other polymer can be used as per requirement.

[0035]

Molding of polycarbonate mentioned above into film or sheet can be carried out by different well-known film formation methods such as solvent cast method, extrusion method, calender method etc. Moreover, desired casted film

or sheet can be obtained by carrying out casting simultaneously while or after this molding. Furthermore, molded film or sheet can be casted and used. In any of the cases, this casting is carried out by different methods such as method using cast roll, molding casting method etc.

[0036]

Temperature at the time of casting should be higher than glass transition temperature of polycarbonate.

[0037]

Moreover, casting of this film or sheet can be carried out along 1 axis direction and magnification of casting along this 1 axis direction (percentage of length of casted part against the original length) should be within the range from 1 ~ 10 %, desirably, within the range from 3 ~ 5 %. This casting can be carried out in 1 step or multiple stages.

[0038]

The thickness of the casted film or sheet thus obtained cannot be decided unconditionally as the optimum value

differs with properties of used polycarbonate (particularly, optical properties such as double refraction (birefringence)) or degree of casting etc., however, generally, it should be within the range from 50 ~ 300 μm . Namely, taking into consideration the double refraction (birefringence) Δn of the casted film or sheet, phase difference compensating film having desired R value can be easily manufactured by appropriately choosing its thickness t .

[0039]

The phase difference compensating film of the present invention thus obtained has less variation in R value (for example, this variation can be easily restricted within 3 %, desirably, within 2 %), and thus, this is a highly functional optical phase difference compensating film and it is useful in different applications such as liquid crystal panel.

[0040]

[Practical examples]

The present invention has been explained below in further details with the help of practical examples. However, the present invention is not restricted only to these practical examples.

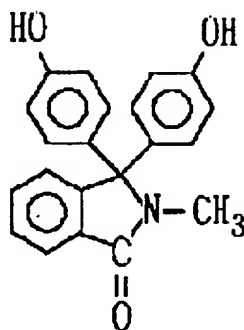
[0041]

Practical example 1

15.4 g (0.051 mol) of bis phenol compound having the structure given below,

[0042]

[Formula 10]



and 42.6 g (0.205 mol) of 2, 2 - bis (4 - hydroxy phenyl) propane taken as raw material monomers, 550 ml of 8 % aqueous solution of sodium hydroxide, 400 ml of methylene chloride,

0.15 g of p - tert - butanol taken as terminal sealing (end capping) agent (molecular weight controlling agent) and 3 ml of 10 % aqueous solution of tri ethyl amine taken as catalyst, were taken in a reactor attached with a barrier plate and polycondensation reaction was carried out by blowing phosgene gas with the proportion of 100 ml/minute simultaneously while maintaining the temperature of reaction liquid in the vicinity of 10°C and stirring it vigorously.

[0043]

After the completion of reaction, organic layer was diluted by adding 1 liter of methylene chloride and it was washed with water, dilute hydrochloric acid and water in this order after which it was poured into methanol when polycarbonate polymer was obtained.

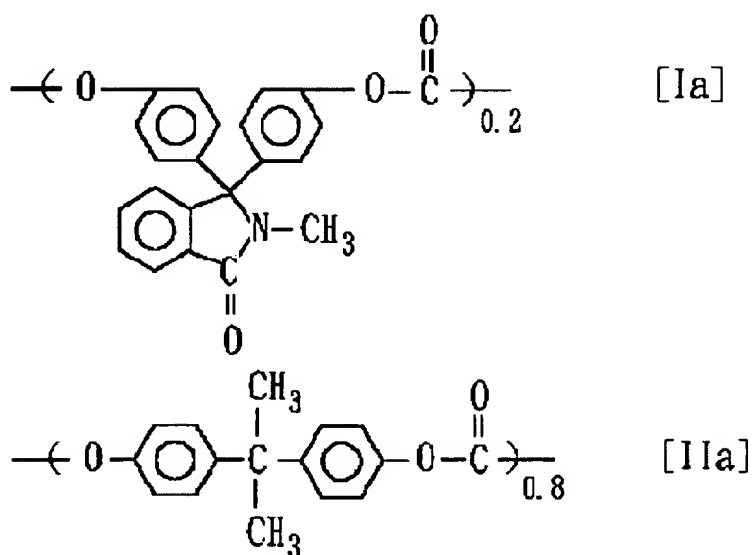
[0044]

The reduced viscosity [η_{sp}/c] of the polymer thus obtained, measured over the solution formed by using methylene chloride

as the solvent and having concentration of 0.5 g/dl at 20°C was 0.78 dl/g. It was confirmed from ^1H -NMR spectrum analysis that it possesses the repetitive units [Ia] and [IIa] given below in the molar ratio given below.

[0045]

[Formula 11]



The polycarbonate mentioned above was molded into a transparent film having thickness of 120 μm and width of 500 mm by extrusion and this film was casted 5 % along 1 axis at 160°C and phase difference compensating film having uniform thickness of 100 μm was obtained. This obtained

phase difference compensating film was cut into width of 400 mm and length of 1 m and double refraction (birefringence) was measured by using Senelmon (?) compensator attached to a polar microscope at $8 \times 20 = 160$ locations at the interval of 50 mm and R value was calculated. Halogen lamp was used as the light source. The measurement results have been presented in table 1 given below. Moreover, this film was showed uniform hue under crossed nicols.

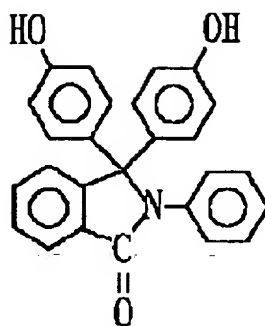
[0046]

Practical example 2

With reference to practical example 1, 20.0 g (0.051 mol) of bisphenol compound possessing the structure given below and 54.9 g (0.205 mol) of 1, 1 - bis (4 - hydroxy phenyl) cyclo hexane, taken as monomers were used.

[0047]

[Formula 12]



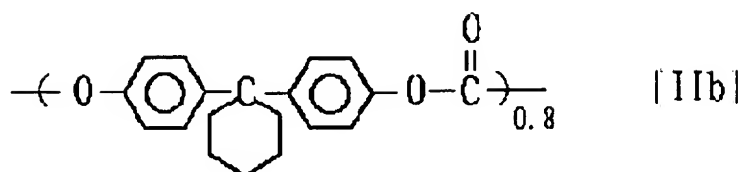
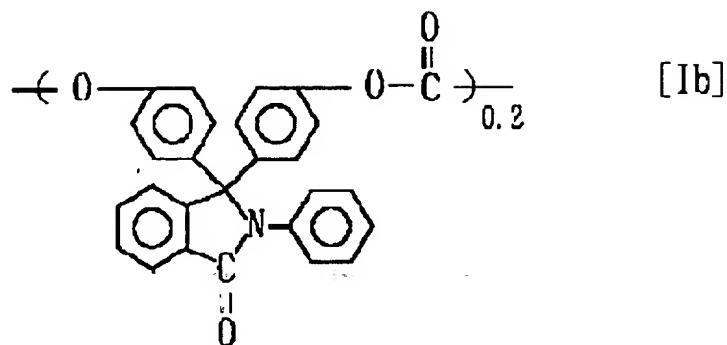
Other than this change, procedure similar to practical example 1 was used and polycarbonate was obtained.

[0048]

The reduced viscosity $[\eta_{sp}/c]$ of the polymer thus obtained, measured over the solution formed by using methylene chloride as the solvent and having concentration of 0.5 g/dl at 20°C was 0.81 dl/g. It was confirmed from ^1H -NMR spectrum analysis that it possesses the repetitive units [Ib] and [IIb] given below in the molar ratio given below.

[0049]

[Formula 13]



This polycarbonate was used and phase difference compensating film was prepared by the procedure described in practical example 1 and its R value was measured. The measurement results have been presented in table 1 given below. Moreover, this film was showed uniform hue under crossed nicols.

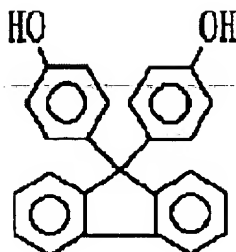
[0050]

Practical example 3

With reference to practical example 1, 20.0 g (0.051 mol) of bis phenol compound possessing the structure given below and 72.2 g (0.205 mol) of 4, 4' - di hydroxy tetra phenyl methane, taken as monomers were used.

[0051]

[Formula 14]



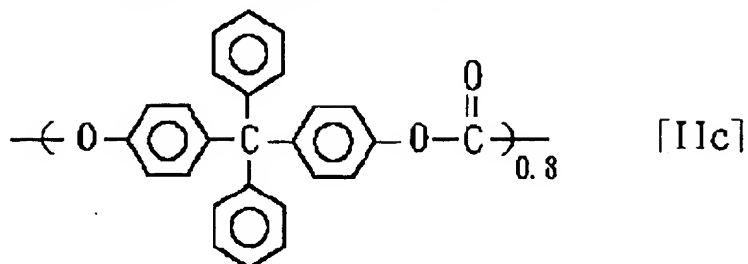
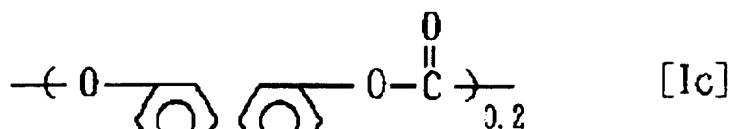
Other than this change, procedure similar to practical example 1 was used and polycarbonate was obtained.

[0052]

The reduced viscosity $[\eta_{sp}/c]$ of the polymer thus obtained, measured over the solution formed by using methylene chloride as the solvent and having concentration of 0.5 g/dl at 20°C was 0.82 dl/g. It was confirmed from ^1H -NMR spectrum analysis that it possesses the repetitive units [Ic] and [IIc] given below in the molar ratio given below.

[0053]

[Formula 15]



This polycarbonate was used and phase difference compensating film was prepared by the procedure described in practical example 1 and its R value was measured. The measurement results have been presented in table 1 given below. Moreover, this film was showed uniform hue under crossed nicols.

[0054]

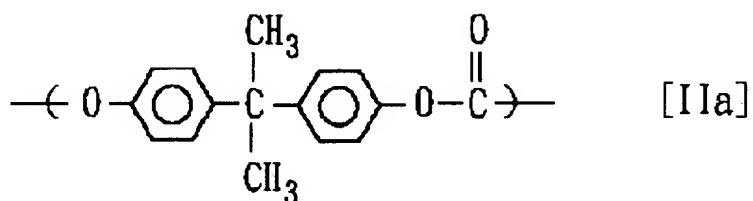
Comparative example 1

Polycarbonate formed from repetitive units [IIa] given below manufactured by reacting the marketed polymer, 2, 2 - bis (4 - hydroxy phenyl) propane with phosgene (terminal sealing (end capping) agent p - tert butyl phenol) ($[\eta_{sp}/c]$

= 0.76 dl/g) was used and phase difference compensating film was prepared by the procedure described in practical example 1 and R value of the obtained film was measured. The measurement results have been presented in table 1 given below. Moreover, this film was observed under crossed nicols when remarkable unevenness in the hue was observed.

[0055]

[Formula 16]



[0056]

[Table 1]

	R value (nm)	Variation in R value (nm)	Variation (%)
Practical example 1	298	6.0	2.0
Practical example 2	386	8.5	2.2
Practical example 3	420	7.1	1.7
Comparative example 1	290	247	85.2

[0057]

[Effect / result of the invention]

If the present invention is used, then highly functional phase difference compensating film that can control the R value within an appropriate range and reduce the variation in R value easily within 3 %, further 2 % can be offered due to use of casted film or sheet formed from polycarbonate having a specific structure. Therefore, it is suitable to be used as phase difference compensating film used in liquid crystal panel.

[0058]

Moreover, if the present invention is used, then unevenness in product quality due to variation in R value, not only in the same film, but also in different products can be remarkably reduced due to which process of production and productivity can be improved.

Continued from front page

(51) Int. Cl.⁵ Discrimination Internal Arrangement

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Location for display of technology

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